IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Christopher M. Hanna
Title:	BTSC ENCODER
Serial No.:	09/638,245
Filing Date:	14 August 2000
Examiner:	Lee, Ping
Group Art Unit:	2615
Docket Number:	56233-139 (THTK-3DVCN)
Confirmation No.:	1379

SUBMITTED VIA EFS-WEB

Mail Stop Amendment
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Declaration of Dr. John Strawn Pursuant to 37 C.F.R. § 1.132

Sir or Madam:

I, Dr. John Strawn, hereby declare as follows:

I. INTRODUCTION

1. In preparing this declaration I have reviewed the application identified above (hereinafter the "Patent Application"), and the most recent Office Action dated July 11, 2008 issued with respect to the Patent Application ("Office Action"). I have also reviewed the prior art references that were cited and applied in the rejection of the claims, and the most recently filed response, Amendment G, filed on January 11, 2009.

2. My curriculum vitae is attached as Exhibit A. My relevant background and experience can be summarized as follows: I am an independent consultant who has been involved with digital audio and digital music since 1973. I have published articles concerning

digital audio in peer-reviewed journals. I have edited textbooks in digital signal processing and digital audio, some of which are considered classics. I have ongoing involvement as a signal processing consultant specializing in digital audio. My involvement includes and has included research, implementation of signal processing algorithms, keynote addresses at conventions, chairing a standards body, and chairing conventions of the Audio Engineering Society (of which I am a Fellow). I have been a faculty member at the University of Colorado, Denver.

3. I received my undergraduate degree at Oberlin, where I worked in 1973 with punched cards and mainframe computers to create digital sound. As a Fulbright Scholar at the Technical University in Berlin for two years, I was involved with analog and digital audio. My Ph.D. dissertation at Stanford involved digital signal processing analysis of digitally recorded sound (before the compact disc was invented). Since graduating from Stanford in 1985, I have been an engineering and a research/development manager in industry. For almost two decades I have maintained an independent practice as a signal processing consultant specializing in audio and music.

4. My specialty as a consultant is implementation of signal processing algorithms for audio and music on the kinds of processors such as the Motorola 56000 family mentioned in the Patent Application [p. 30, line 13]. To give one example of my mission-critical work, I am told that my Motorola 56000 family implementation of Verance Inc.'s proprietary watermarking algorithm is used on the audio tracks of every movie DVD released by American motion picture studios.

5. My experience as a technical expert in patent litigation includes testifying at trial regarding technical issues relating to audio and digital signal processing. I testified as a defense

expert in Lucent v. Microsoft, which I understand involved the largest patent jury award in US history.

6. Because of my consulting work I am familiar with the BTSC specification referenced in the Patent Application. For example in 2002 I assembled a team that helped design a chip for a major chip manufacturer that complies with the BTSC specification.

7. Based on my education and work experience, at the time of the invention claimed in the Patent Application, I believe I was, and still am, a person having ordinary skill in the art of signal processing for audio.

8. At the time of the earliest priority date of the Patent Application (June 7, 1996), I believe that no one had successfully designed a digital BTSC encoder or decoder because the problems involved in developing such devices were formidable. Some of the reasons are described below in the context of discussing the prior art cited and applied by the Examiner.

II. THE CLAIMED INVENTION IS NOT OBVIOUS

9. It is my understanding that all of the pending claims of the Patent Application (claims 60-93 and 104-120) have been rejected under 35 U.S.C. § 103(a) as being unpatentable over individual and combined prior art references.

10. I have reviewed the Examiner's 35 U.S.C. § 103(a) rejections and the prior art cited by the Examiner in that rejection. I respectfully submit that the Examiner's rejections of the pending claims of the Patent Application based on those references was improper because the invention claimed in the Patent Application would not have been obvious to a person having ordinary skill in the art at the time the invention was made. I have provided a more detailed response below, including my reasons.

III. THE CLAIMED INVENTION IS NOT OBVIOUS IN VIEW OF APPLICANT'S FIG. 1 AND HOLT

A. Each Claim Involves the BTSC Standard

11. Each of claims 60-77 in the Patent Application specifies a "digital BTSC compliant L+R signal" and a "digital BTSC compliant L-R signal." Claims 78-81 specify a "BTSC encoded stereo signal." Claims 87-93 specify a BTSC signal. Claims 104-121 again invoke the BTSC standard. Because the proposed claim language specifically requires a BTSC-compatible signal or compliance with the BTSC standard, in what follows I assume that certain requirements posed by the BTSC standard need to be addressed by the cited prior art.

B. The Holt Encoder Is Not Similar To The Invention In The Patent Application

12. The Examiner has rejected claims 60-77, 83-84, 86-89, 91, 109, 110, 112-115 and 199 under 35 U.S.C. § 103(a) as being unpatentable over the applicant's admitted prior art as illustrated in Fig. 1, and in view of Holt. The Examiner first addresses claim 87, and states that

> "one skilled in the art would have expected that the encoded sum signal and the difference signal could be reconstructed at the decoder at the receiving end to yield a left signal and a right signal, or a monophonic signal. The prior art as illustrated in Fig. 1 was implemented using analog circuitry in accordance with the standard defined by BTSC. However, Fig. 1 fails to show how to implement the encoder by using digital circuitry. [Office Action p. 6]

The Examiner's statement is a characterization of the illustration in Fig. 1. The Examiner then refers to the Holt patent, asserting that Applicant's Fig. 1 when considered with the teachings of Holt makes the invention, as defined by the rejected claims, obvious. The rejection and the Examiner's reasons are respectfully traversed.

13. The Office Action states: "Holt teaches a similar encoder also including a L+R path and a L-R path to transmit L and R stereophonic signal to a receiver having a decoder (to reconstruct) to obtain left and right signals (applied to the left and right speakers)." [Office Action p. 7]

14. I respectfully submit that the encoder of Holt is not similar enough to the encoder as claimed in the Patent Application when considered alone or in combination with Fig. 1 of the Patent Application to warrant rejection of the claims under 35 U.S.C. § 103(a).

15. The first difference between Holt and claim 87 concerns multiplexing. Holt has multiplexor 17 in Fig. 2. While BTSC in claim 87 may appear at first glance to take advantage of multiplexing, BTSC in fact does not. The BTSC standard as recited in Claim 87 sums signals (for example Composite Modulator 822 in Fig. 8b, specification text p. 8 lines 8-27, and claim 87). One of ordinary skill understands that in the system of claim 87, the conditioned sum signal and the encoded difference signal are summed after appropriate modulation, forming the "composite signal" of the claim 87 and shown in Fig. 2 of the Patent Application.

16. The manner in which signals sum has profound implications for the design of the system defined by claim 87 which follows the BTSC specification. For example, the conditioned sum signal and the encoded difference signal of the BTSC specification, if not properly implemented, will interfere with each other. Such interference is impossible with the multiplexor of Holt, and Holt does not address such interference.

17. A second difference deals with the pilot tone. In the BTSC specification as recited in claim 87, the pilot tone is also summed, as shown in Patent Application Fig. 2 (f_H). The pilot tone, as taught in the Patent Application, motivates the highly unorthodox sample frequency of 15,734 samples/sec "so as to prevent interference between the signal information of

the encoded signal with the pilot tone signal." [specification p. 11 line 22] Holt's multiplexor does not face the problem of how to incorporate the pilot tone, and does not solve that problem.

18. A third significant difference between Holt and limitations of claim 87 deals with filtering with regard to the composite signal and the pilot tone. Filtering is required in the BTSC of claim 87 and the Patent Application to skirt around the pilot tone f_H :

> "It is important for encoder 200 to insure that the conditioned sum and encoded difference signals do not contain enough energy at the pilot frequency f_H to interfere with the pilot tone that is included in the composite signal. As will be discussed in greater detail below, it is therefore desirable for at least some of the filters in digital encoder 200 to provide an exceptionally large degree of attenuation at the pilot frequency f_H, and this choice of sampling frequency f_s simplifies the design of such filters." [Patent Application specification pp. 14-15]
>
> "Low pass filter 224 provides processing that is partially analogous to bandlimiter 124 (shown in Figure 1) of [BTSC] encoder 100. Low pass filter 224 preferably provides a flat amplitude response in a pass band of zero to 15 kHz and a relatively sharp cutoff above 15kHz. Filter 224 also preferably provides an exceptionally large degree of attenuation at the frequency f_H of the pilot tone (i.e., 15,734 Hz). By providing this exceptionally large degree of attenuation, filter 224 insures that the conditioned sum signal does not include enough energy at the pilot frequency f_H to interfere with the pilot tone used in the composite signal. As discussed above, selecting the sampling frequency f_H to be equal to an integer multiple of the pilot frequency f_H simplifies the design of a filter that provides an exceptionally large degree of attenuation at the pilot frequency and therefore simplifies the design of filter 224. Filter 224 preferably has a null at the pilot frequency f_H and preferably provides at least 70 dB of attenuation for all frequencies from the pilot frequency f_H up to one-half the sample rate.
>
> Figure 4A is a block diagram illustrating one preferred embodiment of low pass filter 224. As shown in Figure 4A, filter 224 may be implemented by cascading five filter sections 310, 312, 314, 316, 3 18. In one preferred embodiment, all five filter sections 310, 312, 314, 316, 318 are each implemented as a second order IIR filter having transfer functions H(z) which are described by the formula shown in the following Equation (4).
>
> $$H(z)=\frac{b_0+b_1z^{-1}+b_2z^{-2}}{1+a_1z^{-1}+a_2z^{-2}} \qquad (4)$$
>
> So in the embodiment shown in Fig. 4A, filter 224 is tenth order IIR filter." [Patent Application specification pp. 17-18]

Holt's filters do not deal with this problem of filtering out f_H because no pilot tone is summed in Holt. Holt's multiplexor sidesteps the problem of adding the sum and difference signals in the application, meaning Holt's filters face significantly looser design constraints.

19. To summarize, in the multiplexor of Holt, the signals do not interact at all. This is a significant difference from the BTSC requirement of claim 87, as well as the other pending claims of the Patent Application, in which the sum and difference signals can interact with each other and the pilot tone. By using a multiplexor, Holt in fact teaches away from the pending claims of the Patent Application.

C. The Filters Of The Patent Application Are Far More Complex Than Those Of Holt

20. A fourth major difference between Holt and the pending claims of the Patent Application deals with filtering in general.

21. The Examiner states in the Office Action:

> "Holt teaches that it is easy to design digital filters providing the precise delay control without corrupting the signals. Accordingly, one of ordinary skill in the art at the time of the invention was made, with prior art as shown in [Patent Application] Fig. 1 and Holt before him/her, would have been motivated to ensure that the signals in L+R and L-R paths are matched, so the stereo relationship between the left and right signals are maintained at the receiver end. Moreover, one of ordinary skill in the art at the time of the invention was made, with prior art as shown in Fig. 1 and Holt before him/her, would have been motivated to embody the analog filters in applicant admitted prior as shown in Fig. 1 using digital technology, which allows a designer greater ability to equalize the delays between multiple paths." [p. 7]

22. The specification of Holt teaches the following:

> "It is relatively easy to construct digital filters having a constant delay response, so that the resultant relative delay, due to the bandlimiting of the difference signal, and any other delays can be compensated for by a digital delay 28 in the sum channel path (or the other channel if appropriate) at any point where the sum signal is in digital form, but preferably between the demultiplexer 19 and decoder 24 in the receiver 8. The digital delay 28 may be realised in known fashion to introduce the precise amount of delay required to

equalize the overall delays of both channels without corrupting the signals in any other way." [3:29-41]

23. As stated above in Paragraphs 15-22, Holt not does not address the BTSC standard of Claim 87. Holt does not provide solutions for the BTSC standard. Holt thus does not address the complexity of the filtering operations required by the BTSC standard. The following paragraphs give more details about the filtering in question.

24. The constraints of the analog filters imposed by BTSC such as shown in the system of Fig. 1 of the Patent Application do not allow the simple solutions of Holt. Holt makes it clear that Holt's L and R signals undergo only a "differential delay" [Holt 2:56], and the difference signal passes through a low-pass filter which has a delay characteristic "independent of frequency" [Holt 2:63]. With such constraints, Holt is correct that it is "relatively easy" to construct a compensating filter, as quoted above. However, the BTSC system is significantly different, as quoted above.

25. I agree with statements made in the Patent Application specification that "there is no simple way to construct an encoder using digital technology that is functionally equivalent to the idealized encoder 100 defined by the BTSC standard." [p. 9 lines 23-25] One of ordinary skill in the art understands that the filters in the BTSC specification for the difference channel involve feedback terms. Such feedback terms introduce a phase response that is far more complicated than the simplistic straight delay of Holt. That the filters in BTSC involve feedback terms and thus a more complicated phase response follows by inspection of the formulas for the filter transfer functions required to implement the claims. For example, the specification gives this exemplary formula for the variable pre-emphasis filter transfer function:

$$S(f, b) = \frac{1 + \frac{\left(\frac{jf}{F}\right)(b+51)}{(b+1)}}{1 + \frac{\left(\frac{jf}{F}\right)(1+51b)}{(b+1)}}$$

[specification p.33] The filters described in the Patent Application for implementing BTSC and in which the transfer function includes a feedback (denominator) term are inherently incapable of satisfying Holt's assumption about "constant delay," that is, a fixed delay at all frequencies. It follows that it takes more than the simple delay of Holt to compensate for the complicated phase response of the filters used in the difference channel of a BTSC system. Therefore, the simple design of Holt does not anticipate or make obvious the system as defined by claim 87 in the Patent Application, nor for that matter to any of the other rejected claims.

26. I respectfully disagree in particular with the Examiner, when she writes that the digital technology of Holt "allows a designer greater ability to equalize the delays between multiple paths." [Office Action, p. 7] In my opinion, equalizing the delays between multiple paths in the BTSC system of claim 87 is in fact a non-trivial problem. Even for one of ordinary skill in the art, such filter design work is a significant challenge. I believe that considerable inventive work is required to derive workable filter solutions to the problems posed by the BTSC specification of claim 87. The Patent Application discloses to the public the result of that inventive work, in the exemplary form of Table 1 [Patent Application specification p. 30-32], which is sufficient to enable the BTSC invention of claim 87. Holt does not disclose such information for BTSC audio processing as cited in claim 87 in the Patent Application.

27. Yet another difference between Holt and the BSTC implementation of the Patent Application involves real-world design tradeoffs. The specification of the Patent Application discloses to the public the inventive work involved in weighing design tradeoffs and solving problems that crop up in the digital domain, such as on pp. 40-41 and Figures 8b-d of the Patent Application. Holt does not address these issues. Such tradeoffs would not have been readily apparent even to one of ordinary skill in the art at the time the invention was made. Weighing such tradeoffs is required to implement claim 87, which proves the non-obvious nature of the subject matter of the claim.

28. The Examiner has relied on the disclosure associated with Fig. 1 of the Patent Application, taken in view of Holt, to reject all of the other pending claims. The comments in Paragraphs 15-27 above apply not only to claim 87, but also to claims 60-86, 88-93 and 104-121. As stated above, each of claims 60-93 and 104-121 invokes the BTSC standard. The Holt reference cited in the Office Action does not allow one of ordinary skill in the art to implement the claims in a straightforward manner. In fact, such as effort would require undue experimentation amounting to real inventive steps that would not be obvious. Because the proposed claim language specifically requires a BTSC-compatible signal or compliance with the BTSC standard, the filter design constraints discussed in Paragraphs 20-27 above for claim 87 also apply to all of the other claims in the Patent Application.

29. One might argue that there is a significant difference between claim 87 and certain other claims. According to this line of reasoning, claim 87 specifies a digital composite modulated BTSC signal. Claims such as 60-81further specify an analog output. As noted above, each claim invokes the BTSC standard. It is clear to one of ordinary skill in the art that the invention in the Patent Application is ultimately involved in analog transmission, precisely

because the BTSC standard is involved. Thus, the distinction between "analog" and "digital" outputs in the claim language has no effect on the points made in the preceding paragraphs. For example the filtering of BTSC compatible signals is required, no matter whether an individual claim foresees an analog output or a digital output (which will then be incorporated into analog transmission).

D. Holt As Cited By The Examiner Does Not Render The Patent Application Obvious

30. To summarize, as identified in the preceding paragraphs, Holt does not disclose a system similar to that described and claimed in the Patent Application. Holt does not enable one of ordinary skill in the art to address or solve the phase response issues involved in implementing the BTSC specification. I respectfully submit therefore that the Examiner's rejection is improper and that the Examiner's rejection of the pending claims based on this reference should be withdrawn.

IV. THE CLAIMED INVENTION IS NOT OBVIOUS IN VIEW OF APPLICANT'S FIG. 1, HOLT + WALKER

A. The References Cited by the Examiner, Even if Combined, Do Not Render the Patent Application Claims Obvious

31. In paragraph 7 (p. 8) of the Office Action, the Examiner has rejected claims 78-81, 85, 104, 105-108, 111, 116-118 and 120 under 35 U.S.C. §103(a) as being unpatentable over applicant admitted prior art as illustrated in Fig. 1 in view of Holt as applied to claim 82 [sic], and further in view of Walker.

32. The Examiner states in the Office Action:

> "Regarding claims 78, 80, 85, 104, 105-1 08, 1 11, 1 16-1 18 and 120 as indicated above, the prior art as shown in Fig. 1 uses analog device for encoding the sum and difference signals, so the compression is also performed by analog device. Both the prior art as

shown in Fig. 1 and Holt fail to show an adaptive weighting system. Walker teaches a digital compander transmitting digital audio signal (col. 1, line 17). Walker suggests an adaptive weighting system to correct errors included by the compression and expansion processes (col. 1, lines 56-58). Accordingly, one of ordinary skill in the art at the time of the invention was made, with all three references before him/her, would have been motivated to use an adaptive weighting system for performing the compression as required by BTSC in order to transmit the stereophonic source to the receiver without incurring error." [pp. 8-9]

33. Walker calculates on an ongoing basis the errors *introduced by* Walker's system, and attempts to correct for these errors before transmission [Walker 2:23, 4:33-38]. In Walker, these errors are calculated and are thus known before transmission. However, the system as defined by BTSC in each of the claims numbered 78-81, 85, 104, 105-108, 111, 116-118 and 120 in the Patent Application involves errors that will happen that are unknown or at best coarsely characterized. Thus, the adaptive system of Walker is compensating for a kind of error different from that of the claimed BTSC system of the Patent Application.

34. Beyond Walker's adaptive correction, Walker treats errors in the transmission medium differently from the claimed BTSC system of the Patent Application. Walker assumes that the transmission medium between his Fig. 1 and Fig. 2 is transparent, or at least that the error rate is bounded [Walker column 8 lines 1-25]. Walker assumes noise bursts [Walker 8:47] that corrupt the digital signal, and provides efficient methods for minimizing the effects of such noise bursts. These methods include the error-correcting and error-detecting codes in Walker columns 7 and 8. In contrast, the term BTSC in the pending claims of the Patent Application suggests a spectral rolloff at the higher portions of the difference channel [Specification p. 3 lines 9-10]. One of ordinary skill understands that this spectral rolloff is more or less constant across time, or at least slowly time-varying. The claims of the Patent Application define a system that implements a method to minimize the effects of the spectral rolloff. This is a problem fundamentally different from the noise bursts of Walker.

35. Similar to Holt, Walker teaches a system that transmits an interleaved [Walker Fig. 1, 7:16, 8:30-49, Table 4] signal, in which the bits of both channels are co-mingled without summing the two audio signals. But the claimed BTSC system of the Patent Application requires a signal in which both channels sum. As stated above in paragraphs 15-19 with regard to Holt, the system claimed in the Patent Application has to account carefully for interactions between the channels, but Walker does not.

36. As was discussed above, filtering in accordance with the BTSC standard is required in each and every pending claim of the Patent Application. Even if one were motivated to combine the disclosure of Applicant's Fig. 1 with Holt and Walker, Walker combined with Holt does not teach how to appropriately design digital filters that approximate the filter frequency and phase responses required by the BTSC specification invoked in the claims, even in light of Fig. 1 of the Patent Application.

37. Thus, the combination of Application's Fig. 1, Walker and Holt does not teach the subject of the claim language. I respectfully submit therefore that the Examiner's rejection is improper for this reason and that the Examiner's rejection of the pending claims based on this combination of references should be withdrawn.

B. A Person Having Ordinary Skill in the Art Would Not Have Been Motivated to Combine the References Cited by the Examiner

38. The Office Action states:

> "Accordingly, one of ordinary skill in the art at the time of the invention was made, with all three references before him/her, would have been motivated to use an adaptive weighting system for performing the compression as required by BTSC in order to transmit the stereophonic source to the receiver without incurring error." [p. 9]

I respectfully submit that the proposed motivation to combine mis-states the purpose of Walker, Holt, and Fig. 1 of the Patent Application. For this reason, I submit that one of ordinary skill in

the art would not have been motivated to combine Fig. 1 of the Patent Application, Holt and Walker to invent the claimed system of the Patent Application.

39. The claimed BTSC system of the Patent Application does not function to transmit "without incurring error." The Patent Application specification states, for example: "the difference signal is subjected to additional processing than that of the sum signal so that the dynamic range can be substantially preserved." [p. 3 lines 15-16]; and "the signal-to-noise ratio of the GR signal applied to the difference channel processing section 130 will be substantially preserved." [p. 7 lines 7-8] "Substantially preserving" something is different from processing something "without incurring error."

40. In contrast, Holt clearly incurs error. For example Holt states that "the 'left' and 'right' outputs are only true stereo in the 0-2 kHz frequency range, outside this range the two output signals are identical." [3:42-44] Thus, there is an error in the two signals above 2 kHz, which would normally not be identical. Such an error produces distortion in the placement of signals between the left and the right speaker. In a television show sound track, for example, such errors cause the voice of the actor to drift into just one speaker, sometimes even for a syllable or so. Many listeners perceive such a distortion as disconcerting. Also, the ADPCM system used by Holt [3:1-4 and Fig. 2, blocks 15 and 16] inherently introduces errors into a signal. Thus, Holt does not process "without incurring error."

41. Walker admittedly attempts to correct errors introduced by Walker's encoder but openly discusses errors that can only be minimized but not completely removed (for example Walker 9:49-52). Walker's block magnitude encoding scheme (starting at Walker 4:22) inherently introduces errors into the signal. Thus, Walker does not process "without incurring error."

42. Thus, I respectfully submit that the Office Action has not provided a motivation to one skilled in the art, to combine Walker with Holt in light of Fig. 1 disclosed in the Patent Application, to create the invention of the claims of the Patent Application.

43. In summary, I believe that all of the pending claims are patentable over Fig. 1 of the Patent Application taken in view of Holt and Walker.

V. GENERAL INFORMATION

44. I declare that the statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued based on the Patent Application.

SIGNATURE:

John Michael Strawn

DATE: 3 April 2009

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RESUME

John M. Strawn, Ph.D.

Goal: Continue full-time consulting in my own corporation, writing software and testifying as an expert witness.

Expert Witness and Litigation Support Experience

Date:	2008-2009	**Sidley Austin, Chicago**
	Case:	Undisclosed
	Project:	Analyze C/C++ source code for defendant in patent action involving Internet-based multimedia file downloading system running in Windows. Worked with multiple versions of client and server code contained in more than 60,000 files occupying more than 3 GByte disk space.
	Status:	Plaintiff dismissed, 2009.

Date:	2005-2007	**Fish and Richardson, San Diego, CA**
	Case:	Lucent Technologies Inc. v. Gateway, Inc., et al., defendants, and Microsoft Corporation, Intervener. Case No. 02-CV-2060 B (CAB) consolidated with 03-CV-0699 B (CAB) and 03-CV-1108 B (CAB).
	Project:	Expert for defense (Microsoft) involving audio compression and MP3. Two days testimony at three-week jury trial, February 7-8, 2007, cross-examined by Kirkland and Ellis. Prepared 8 expert reports (total 331 pages) on non-infringement and invalidity including 20 claim charts and 15 other substantive attachments. Analyzed over 4000 pages of C/C++ source code; analysis of assembly and machine code. Worked directly with German documents. Deposed, November 3, 2006.
	Status:	Judge Brewster overturned jury decision and ruled in favor of defense. Judge Brewster's decision upheld on appeal, September 2008, http://www.cafc.uscourts.gov/opinions/07-1546.pdf

Date:	2007 - 2008	**Fish and Richardson, Atlanta**
	Case:	Nice Systems Inc. and Nice Systems Ltd. v. Witness Systems Inc. Civil Action No. 06-311-JJF, Delaware District.
	Project:	Testifying expert for the defense involving telephone call centers (telephony, software, hardware architecture, digital recording.) Prepare

		claim charts, expert reports. Deposed January 2008. Testified at one-week trial, Wilmington, DE, January 2008.
	Status:	Hung jury. Settled at terms favorable to my client, August 2008.
Date:	2007	**Law firm: Morrison and Foerster, Los Angeles**
	Case:	3:06-cv-7736 CA Northern District, Seer Systems v. Yamaha
	Project:	Prior art research; documents from my own files; commentary on prior art found by me and by attorneys; meetings with attorneys and their client in Los Angeles.
	Status:	Settled before trial at terms favorable to my client.
Date:	2006-2007	**Law firm: Mayer Brown Rowe & Maw, Houston, TX**
	Case:	2:06-cv-156, Digital Technology Licensing (DTL) v. Cingular Wireless
	Project:	Prepare claim charts, technology background. Two-day meeting with attorney in Palo Alto.
	Status:	Case settled on terms favorable to client.
Date:	2007	**Law firm: Meyer & Associates Co. LPA, Columbus, Ohio**
	Case:	Health Science Products LLC and Kairos & Associates, In., v. Sage Software SB, Inc.
	Project:	For class action litigation, analyze functionality of database software before and after release of ACT 2005 (Version 7.0). Analyze software failure using databases provided by plaintiffs.
	Status:	Settled, payments to affected parties in progress 2008.
Date:	2005-2006	**Law firm: Black Lowe & Graham, Seattle**
	Case:	Digeo, Inc. v. Audible, Inc., Case No. C05-00464-JLR, Seattle
	Project:	Testifying expert for plaintiff in case involving Internet file downloading. Prepare expert reports on validity and infringement. Analysis of C/C++ code. Deposed for Markman hearing, February 2006.
	Status:	Settled, plaintiff lost standing, 2006.
Date:	2006	**Law firm: Ropes and Gray, Palo Alto**
	Case:	MediaTek, ASUSTek & ASUS v. Sanyo
	Project:	Prepare claim charts on 24-hour notice. Assist in preparation of tutorial.
	Status:	Settled, terms unknown. My involvement was limited due to schedule conflicts with previous clients.
Date:	2006	**Law firm: Ropes and Gray, Palo Alto**
	Case:	Undisclosed to me
	Project:	Teach technology relating to audio to attorneys; draft claim charts.
	Status:	Case resolved, terms unknown to me.

Date:	2006	**Law firm: Wilmer Hale (New York)**
	Case:	Information Technology Innovation, LLC v. Motorola, Inc. et al., Northern District of Illinois 04-C-7121.
	Project:	Provide and supervise an expert witness colleague who prepared an expert report on infringement.
	Status:	Settled.
Date:	2004-2005	**Weil, Gotshal & Manges, New York office**
	Case:	Antor Media Corporation v. Apple Computer, Inc., Microsoft Corporation, RealNetworks, Inc., Civil Action No. 2:03CV320 (E.D. Texas 2004)
	Project:	Retained on behalf of Microsoft as a prior art consultant for litigation involving file downloading.
	Status:	Settled on terms favorable to my client, early 2005.
Date:	2005	**Law firm: undisclosed**
	Case:	Undisclosed
	Project:	For a well-known manufacturer of digital hardware, investigate prior art for hardware relating to patents on hardware architecture, virtual memory and cache memory. In addition to library work, provide information from my own files, and gain access to files at private Bay-area institutions.
	Status:	Prior art research submitted to attorneys in 2005.
Date:	2005	**Law firm: Trop, Pruner & Hu, Austin, TX**
	Project:	Provide prior art involving signal processors.
	Status:	My work completed 2005.
Date:	2003	**Law firm: Dechert**
	Case:	Opposed to Lucent; Dechert's client not disclosed to me.
	Project:	Read six articles and two Ph.D. dissertations, all in German, on audio compression, scanning for (and finding) specific prior art as requested by attorney.
	Status:	My involvement concluded in 2003, status unknown.
Date:	2002-2003	**Law firm: undisclosed**
	Case:	undisclosed
	Project:	Working directly for a major audio manufacturer (defendant) in an infringement case, identify prior art relating to hardware for placing sound into 3-space. Provide 15-page claim chart.
	Status:	Settled, terms unknown

Date:	1997-98	**Cesari and McKenna, Boston**
	Case:	Lucent vs. Young Chang/Kurzweil
	Project:	Served on the expert witness team helping defend a major music instrument manufacturer against alleged patent infringement relating to music synthesis. I advised attorneys about digital hardware, software, and architecture. I obtained obscure historical documents and information from various public and private sources. I provided provide personal archives from the 1970's, and I helped the attorneys find other expert witnesses for the team.
	Status:	Settled on terms favorable to my client, 1998.
Date:	1996	**Law firm: undisclosed**
	Case:	Undisclosed
	Project:	For a major karaoke manufacturer outside the USA, I conducted prior art research which helped the company successfully fend off patent violation actions in the area of digital graphics.
	Status:	Settled on terms favorable to my client, 1996
Date:	1995	**Client: Creative Labs**
	Case:	Undisclosed to me.
	Project:	For this well-known manufacturer, I conducted prior art research and prepared a claim chart in the area of music synthesis, especially reverberation. This also included manuals for custom music synthesizers, from my own library.
	Status:	Settled, terms unknown, 1995
Date:	1994	**Law firm: undisclosed**
	Case:	Undisclosed
	Project:	For the same major karaoke manufacturer outside the USA as above, I conducted prior art research which helped the company successfully fend off patent violation actions in the area of digital music synthesis, specifically chorus in karaoke background using MIDI and sampling synthesis. I used contacts in the Bay area to find manuals for hardware prior art for which the manufacturer had gone out of business.
	Status:	Settled on terms favorable to my client, 1994
Date:	1994	**Small, Larkin, Los Angeles**
	Case:	Digital Theatre Systems (DTS) v. L.C. Concepts (plaintiff)
	Project:	For this well-known manufacturer of cinema sound equipment, I participated in the successful resolution of a patent infringement action. I studied and commented on patents and correspondence in English and German. I met with German- and English-speaking corporate and engineering staff in the Bay Area and Las Vegas. Through personal contacts in German-speaking areas in Europe, I located prior art hardware in various private firms.
	Status:	Settled on terms favorable to my client, 1994

Education and Training

Year	College/University	Degree
1973	Oberlin	B. Mus, double degree in organ performance and music theory. Experience with analog synthesizers and digital music synthesis, BASIC, FORTRAN, MUSIC V on an IBM 360.
1973-1975	Technical University, Berlin	Fulbright Scholar. Graduate-level coursework in music theory/history, audio engineering, electronics, information theory, cybernetics, Japanese; all coursework in German. Extensive recording studio and live concert sound reinforcement experience. PDP-11 and PDP-8 assembly and machine language. Travel throughout Europe.
1975-1976	IBM Thomas Watson Foundation	Grant to study electronic music, Tokyo, Japan, 1976. Live performances on piano and Roland System 700 analog synthesizer. Also travel through Turkey, Iran, Afghanistan, Pakistan, India, Thailand, and Hong Kong.
1985	Stanford	Ph.D., CCRMA. Advisor: John Chowning. Graduate course work in music, computer and processor architecture, assembly-language processing, digital audio, acoustics, and digital hardware. Dissertation on analysis of music instruments with the short-time Fourier transform. Software development experience listed elsewhere in this resume.

Employment History

From: 1992 **S Systems, Inc.**
To: Present Larkspur, CA
Position: *Owner*
Duties: Full-time independent consultant:

- **Programming** hand-crafted audio and music software for signal processing, written in C, C++, JAVA, and especially assembly language for digital signal processing chips. Consulting on processor architecture and networking. See Consulting Assignments, below.
- **Testifying Expert witness** in patent litigation relating to software, computers, signal processing. See Expert Witness, above.
- **Recruiter** filling technical positions in hardware and software engineering and management.

From: 1987 **Yamaha Music Technologies USA**
To: 1991 Larkspur, CA
Position: *1989-1991: President; 1987-1989: Vice President*
Duties: Helped establish and manage a nine-person Ph.D.-level research group, including site search, architectural design, construction, move-in, and hiring. Conducted original research on electronic musical instruments, software, micromachining, networking, and recent technological developments. Extensive experience designing scientific, engineering, and musical object-oriented applications, especially C++ (UNIX). Patents listed below.

From: 1986 **S Systems**
To: 1988 Larkspur, CA
Position: *Full-time Consultant*
Duties: This was my first stint as a consultant. See Consulting Assignments, below.

From: 1985 **Lucasfilm/Droid Works**
To: 1986 San Rafael, CA
Position: *Programmer*
Duties: Full-time programming experience as an employee, designing signal-processing modules and writing (96-bit VLIW) microcode for the ASP/SoundDroid developed by James A. Moorer. Experience in audio and video post-production. Extensive work in C (Unix). Another six months full-time experience writing tightly packed assembly code for the TI TMS32010 signal processor, especially for a two-channel hard-disk audio record playback unit that played without bugs on the exhibit floor of the National Association of Broadcasters convention, 1986.

From: 1976 **Stanford University**
To: 1985 Stanford, CA
Position: *Doctoral Student*
Duties: Nine years programming experience developing code in high-level languages (Algol, Fortran, SAIL) and PDP-10 assembly language for musical and audio signal processing applications during doctoral thesis work. Includes original published research in spline fitting and pattern recognition, a 30,000-line two- and three-dimensional graphical editor for waveforms and spectra, implementation (with John Gordon) of the short-time Fourier transform, device drivers, and libraries for graphic user interfaces. Part-time consulting work also for clients such as:

- SRI International (FORTRAN for mechanical engineering).
- Mattel Electronics (music in consumer electronic toys).
- IntelliGenetics (ALGOL-like code for biotechnology).
- Digital Keyboards (product specification and complete manuals for GDS and Synergy Synthesizers).

From:	1972	**Revox**
To:	1972	Long Island, New York
	Position:	*Summer intern*
	Duties:	Solder cables, write German- and Dutch-English translations, manufacture PC boards, assemble hardware.

Consulting Assignments

From:	2008	**Client: DTS Digital Cinema**
To:	2008	Agoura Hills, CA
	Duties:	For DTS Digital Cinema's new XD20 eight-track cinema media player (this is the box that sits in the movie theater projection booths for playback of multi-channel audio and video), adapt audio algorithms from an earlier DTS Digital Cinema device. In particular, port DTS Coherent Acoustics decode (two versions, one 8-channel, one stereo), DTS Digital Cinema 8-channel decode, and DTS Neo6 5.1 decode from DTS Digital Cinema's existing XD10 cinema media player. This required me to extract Motorola DSP563xx assembly language source code from the earlier XD10 environment; isolate the four algorithms by stripping away unneeded code; integrate the four algorithms into Motorola 56721 dual-core processor; and write new wrapper code in assembly language. Responsible for approximately 25,000 lines of assembly-language source.

From:	2007	**Client: undisclosed**
To:	2008	Location: Asia
	Duties:	For this (repeat) client review literature and prepare summary report reviewing current graphic visualization of audio data. The 160-page final report discusses about one-half of the 200 or so documents and other items that I investigated.

From:	2007	**Client: undisclosed**
To:	present	Location: southern California
	Duties:	For this (repeat) client implement, in C, with the help of a filter design subcontractor, a novel algorithm for sound processing.

From:	2007	**Client: Berkeley Design Technology, Inc. (http://www.bdti.com/)**
To:	2008	Location: Oakland, CA
	Duties:	Contribute to research and writing of the following articles on processor architecture at BDTI's website Inside DSP (http://www.insidedsp.com/):

- TI Offers OMAP3 Application Processors to the Mass Market
- Avnera releases ASSPs for wireless audio applications
- XMOS Introduces Low-cost Multi-core Chip Family with Programmable I/O
- VeriSilicon's New Silicon IP Solution for HD Audio

- Behind the scenes: Dolby's acquisition of Coding Technologies
- Tips and Tricks for Debugging Audio

Other BDTI assignments are listed below.

From: 2007 **Client: undisclosed**
To: 2007 Location: Asia
Duties: Review literature on auditory stream separation, computational auditory stream analysis, voice activation decision for speech, and Wiener filters. These techniques are at the cutting edge for improving cell phone sound. Using publicly available Matlab code for Wiener filters (Ephraim/Malah) as a basis, implement Davis et al's voice activation decision in Matlab, delivering a speech enhancement system to the client.

From: 2007 **Client: undisclosed**
To: 2008 Location: San Francisco Bay area
Duties: For this startup just leaving stealth mode, advice on licensing and implementing audio algorithms; assist in integrating audio into portable consumer product.

From: 2006 **Client: undisclosed**
To: 2007 Location: Bay Area, CA
Duties: For a well-known provider of audio software, provide and supervise a subcontractor to port a complicated digital signal processing algorithm into the Digidesign TDM Environment, in Motorola 56K assembly language.

From: 1995 **Client: Yamaha**
To: 2007 Location: Hamamatsu, Japan
Duties: Chair, AES standards working group SC-02-12 on digital audio networking via IEEE-1394 (Firewire), with the support of Yamaha. Involved a trip to AES conventions twice a year, including one in Europe. Past member, IEC TC100 TA4, Digital System Interfaces. Various public appearances worldwide and various company site visits on behalf of Yamaha to discuss multimedia networking, audio over 1394 and Yamaha's mLAN.

From: 2005 **Client: Sonic Network, http://www.sonicimplants.com/**
To: 2006 Location: Somerville, MA
Duties: For this well-known provider of wavetables, synthesis software, and cell phone ring tones (among others), provide and supervise subcontractors for these projects:

- Design and implementation of filters for sample rate conversion;
- Design and implementation of filters following the DLS-2 specification (used in cell phones for ring tones);
- Port synthesizer code to Tensilica HiFi2 audio engine.

From: 2004 **Client: Bias, http://www.bias-inc.com/**
To: 2006 Location: Petaluma, CA
Duties: For this well-known provider of audio software, provide and supervise a subcontractor to port a complicated digital signal processing algorithm into the Digidesign TDM Environment, in Motorola 56K assembly language.

From: 2005 **Client: Audio Research Labs, http:// www.audioresearchlabs.com/**
To: 2005 Location: Scotch Plains, NJ
Duties: For ARL founder Schuyler Quackenbush provide and supervise a subcontractor to design and implement a digital filter algorithm in Motorola 56K assembly language.

From: 2004 **Client: Verance, http://www.verance.com/**
To: 2005 Location: San Diego, CA
Duties: Working closely with Verance R&D staff, implement the Verance Content Management System/Audio-Visual (VCMS/AV) watermarking technology for motion picture sound (www.verance.com/news/releases/ MSFT_Release_2-10-2005.pdf) in Motorola 56300 assembly language in the TC Electronics M6000 environment. This program is used by major film studios starting early 2005 to watermark nearly every DVD released. Travel at client's request to TC Electronics headquarters in Denmark to facilitate integration. Provide and supervise a subcontractor to assist with filter design, filter implementation, and other tasks. More than 30,000+ lines of 56K assembler source, several hundred pages of documentation, a dozen CD-ROMs of debugging data and lab notebooks.

From: 2002 **Client: Universal Audio (http://www.uaudio.com/)**
To: 2004 Location: Santa Cruz, CA
Duties: For this well-known manufacturer of audio plugins, port two audio processing algorithms (Pultec filter, LN1176 stereo compressor) from C/C++ to Motorola 563xx assembly language in the DigiDesign ProTools TDM environment, including numerical approximation and streamlining the original C/C++ implementation. Publicly released 2004. Contribute extensively also to port of an extremely complicated high-end reverberator, and to another equalizer.

From: 2003 **Client: undisclosed**
To: 2004 Location: Bay Area, CA
Duties: For another well-known manufacturer of audio plugins, extensive contributions to the TDM port of a multi-band, multi-channel compressor.

From: 2003 **Client: Stretch (http://www.stretchinc.com/)**
To: 2004 Location: Mountain View, CA
Duties: For this software configurable processor startup, study how to port MPEG-2 AAC and MP-3 decode reference C++ code to 16- and 32-bit integerized C. Do the same for MP-3 encode based on publicly available

source. Learn their software configurable architecture well enough to write optimizations.

From: 2003 **Client: RIC International Precision Translation Services (http://www.ricintl.com/)**
To: 2003 Location: Cambridge, MA
Duties: For this major translation house, proofread German-English translations involving, among other things, audio compression (including German-language doctoral dissertations).

From: 2003 **Client: Analog Devices**
To: 2003 Location: Santa Clara, CA (Audio Rendering Technology Center)
Duties: Port music synthesis algorithms assembly language for theARM7/TDMI processor, following ARM's C calling conventions. This project ran under very tight time constraints, cost only 2/3 of the projected budget, and resulted in code that runs much faster than the original implementation.

From: 2002 **Client: Dorrough Electronics (http://www.dorrough.com)**
To: 2003 Location: Chatsworth, CA
Duties: Implement in C and Analog Devices Sharc 21161 assembly language a novel scheme based on their patented technology to improve the perceived loudness of audio signals sent over broadcast. Provide a subcontractor who made significant contributions to filter design.

From: 2002 **Client: undisclosed**
To: 2003 Location: Santa Cruz, CA
Duties: For a major manufacturer of wireless telecommunications hardware, help create a development environment using Texas Instruments' C54XX, Code Composer Studio, and Reference Framework 3.

From: 2002 **Client: undisclosed**
To: 2002 Location: Japan
Duties: For an Asian manufacturer of audio chips, assemble, manage, and contribute technically to a group of US consultants to specify and help design an audio-related chip used in broadcast applications. Establish contact between the Asian client and stateside holders of appropriate licensable technology.

From: 2002 **Client: Analog Devices**
To: 2002 Location: Wilmington, MA (Ray Stata Technology Center)
Duties: After an on-site visit to learn more about the technology and meet the team, I made recommendations on changes to architecture for a new version of an idiosyncratic signal processing chip. I also provided code examples for the new architecture.

From:	2001	**Client: undisclosed**
To:	2002	Location: Silicon Valley, CA
	Duties:	For a configurable processor manufacturer in Silicon Valley, implement a highly optimized version of the modified discrete cosine transform (MDCT) for audio compression. Extensive investigation of theory and variants of the MDCT. Also port MPEG-2 low-complexity AAC decode and MP3 encode from Fraunhofer/Thomson reference C++ code to 16-bit integerized C. Prepare various optimizations closer to the hardware than C++ usually allows.

From:	2001	**Client: undisclosed**
To:	2002	Location: Europe
	Duties:	For this developer of a custom processor based on ARM architecture, investigate licensing of and make recommendations for porting AC-3, DTS, Dolby ProLogic.

From:	1999	**Client: Berkeley Design Technology, Inc. (http://www.bdti.com/)**
To:	2001	Location: Oakland, CA
	Duties:	• For BDTI's Buyer's Guide to DSP Processors, 2001 Edition, contribute major portions of the text analyzing processor architectures including the Analog Devices TigerSharc, and contribute also to the analyses of Motorola 56300, 56800, and 56800E processors; verification and in some cases re-writing assembly-language implementations of BDTI's benchmarks; • Prepare written analyses of Hitachi SH-DSP, SH3-DSP, SH-4, and SH-5 processor architectures. This again included verification and in some cases re-writing assembly-language implementations of BDTI's benchmarks; • Implement assembly-language routines related to multimedia compression in ARM7/ARM9 processor assembly language; • Develop and present a four-hour presentation on audio compression, given first at Embedded Processor Forum, June, 2000; contribute to a four-hour presentation on digital audio and music given by Dana Massie at the same Embedded Processor Forum; revised and presented both talks at Microprocessor Forum, October 2000; both talks revised again with emphasis on streaming audio and presented at Embedded Processor Forum, June, 2001.

From:	1995-1996	**Client: Audio Precision (http://www.audioprecision.com)**
And	1998-1999	Location: Portland, Oregon
	Duties:	Audio Precision (Portland, Oregon). For their System 2 audio measurement device, developed double-precision Fourier transform (FFT) in assembly language for Motorola 56002 processor, including (Microsoft) C code to study where to maintain double-precision. Also, extensive code

for AES/EBU and square wave measurement test suite, including jitter and eye pattern (assembling bit map for graphics display in 56002 data memory space). 28K+ lines of assembly language source. 1998-1999: Revise Audio Precision System 2 code for new 96 kHz Cascade hardware (Motorola 56303).

From: 1997 **Client: Euphonics (later part of 3COM)**
To: 1999 Location: Boulder, CO
Duties: Implement Dolby AC-3 decoder (used in Dolby Digital cinema sound) in 16-bit integer assembly language on new Analog Devices 16-bit integer AD1818 processor (PCI SoundComm). 20K+ lines of assembler source. Passed first round of Dolby testing on first try. Integrate with Euphonics' Real-Time Kernel operating system.

From: 1998 **Client: undisclosed**
To: 1999 Location: Silicon Valley, CA
Duties: Assist a startup specializing in real-time music software in its attempts to be acquired. Included introducing company staff to personal contacts in various music companies, and participating in various meetings.

From: 1998 **Client: undisclosed**
To: 1998 Location: Silicon Valley, CA, and southern CA
Duties: For a major chip manufacturer, I served as the sole outside member of the due diligence technical team evaluating a small but well-known synthesizer company ultimately acquired by the chip manufacturer. After visiting the synthesizer company's office with a team from my client, I provided a detailed written report on software, music synthesis chip architecture, and various management questions.

From: 1996 **Client: Digital Technics (DTI)**
To: 1997 Location: Baltimore, MD.
Duties: Implementation of CCITT R2 telephony encoder/decoder (similar to DTMF) in Motorola 56002 assembly language, based on Goertzel algorithm. 13K+ lines assembler. Deployed in the field in Asia and South America.

From: 1996 **Client: VM Labs**
To: 1996 Location: Los Altos, CA
Duties: For this multimedia chip startup, provide detailed critique of their proprietary DSP chip architecture.

From: 1994 **Client: undisclosed**
To: 1995 Location: Asia
Duties: For a major manufacturer of audio hardware, commissioned to write a study of audio over networks. Investigate and deliver a 40 page report analyzing MIDI, ZIPI, 1394, PCMCIA, Ethernet, ATM, Lone Wolf, USB, and others.

From:	1993	**Client: Oculix**
To:	1995	Location: Switzerland
	Duties:	Motorola DSP 56000 assembly language for numerical and FFT analysis of real-time data gathered by laser from the human eye for medical applications. 150K source.
From:	1993	**Client: Centigram Communications Corporation.**
To:	1994	Location: Silicon Valley CA (apparently now part of SS8 Networks)
	Duties:	Port of speech synthesis code from TI TMS320E17 assembly language to Motorola DSP 56002 assembly language on Motorola PC Media card; port to Analog Devices ADSP 2115 assembly language on Echo Personal Sound System.
From:	1993	**Client: Atari**
To:	1994	Location: Sunnyvale, CA
	Duties:	implement physical modeling music synthesis techniques on custom RISC/DSP chip inside Jaguar game console. Prepare written comments on a new custom DSP architecture.
From:	1993	**Client: undisclosed**
To:	1993	Location: New England
	Duties:	For a US audio manufacturer, write audio recording, storage, and playback functions in assembly language for Analog Devices ADSP 2105. Farmed out DAC/ADC device drivers to subcontractor. Also farmed out front-panel code on Philips/Signetics 80C51 family of controllers to different subcontractor.
From:	1993	**Client: Euphonics**
To:	1993	Location: Boulder, CO
	Duties:	For this software music synthesizer company, write C routines to emulate certain hardware elements in the target architecture. This allowed the company to study aspects of caching parameter updates, for optimizing real-time performance.
From:	1993	**Client: undisclosed**
To:	1993	Location: Bay Area, CA
	Duties:	For a research project involving DSP architecture, write a series of Java classes to emulate the typical components of a DSP chip.
From:	1987	**Client: Shure**
To:	1988	Location: Evanston (now Niles), IL
	Duties:	Working from the written specification for a proprietary algorithm, develop C and TI TMS 32010 assembly language for a multi-channel consumer audio product prototype.

From:	1987	**Client: NeXT, Inc.**
To:	1988	Location: Silicon Valley, CA
	Duties:	NeXT Inc. Developed, debugged, and documented more than 50 routines in the Motorola DSP 56000 assembly language vector library (with Julius O. Smith; source code printout is 2" thick.). While working off-site for over a year before NeXT was publicly released, maintain secrecy about the fact that NeXT would include a 56000 processor.

From:	1986 or 1987	**Client: Sonic Solutions**
To:	1986 or 1987	Location: San Francisco CA
	Duties:	As one of the first consultants hired by Sonic Solutions (located in their first office in San Francisco), port their C-language noise-reduction code from one flavor of Unix to another.

Other experience:

- Studies of micromachining and nanotechnology.
- Experience with the Star Semiconductor SPROC chip, the IBM MWAVE chip and operating system, OS-9, and Spectron's SPOX operating system.

Patents

Patent Number	Date Issued	Title
5,569,871	October 29, 1996	Musical tone generating apparatus employing microresonator array (co-inventor; micromachining)
		As Vice-President and President of Yamaha Music Technologies Inc., I supervised the patent applications by my employees that resulted in US patents 5,245,130, 5,288,938, 5,386,568, 5,422,956, 5,536,902, and 5,541,358.

Teaching appointments

From:	2003	**University of Colorado at Denver, College of Arts & Media**
To:	2008	Denver, CO
	Position:	*Lecturer, College of Arts & Media*
	Duties:	Teach special topics course on audio data compression to upper-level undergraduate and graduate students.

Major Publications

- "Approximation and Syntactic Analysis of Amplitude and Frequency Functions for Digital Sound Synthesis." *Computer Music Journal* 4(3):3-22, 1980.

- *Modeling Musical Transitions.* Ph.D. Thesis, Stanford University, 1985. 243 pp.

- (with C. Roads). *Foundations of Computer Music.* MIT Press, 1985. 600 pp.

- *Digital Audio Engineering: An Anthology.* Madison, WI: A-R Editions, 1985. 144 pp.

- *Digital Audio Signal Processing: An Anthology.* Madison: A-R Editions, 1985. 283 pp.

- "Orchestral Instruments: Analysis of Performed Transitions." *Journal of the Audio Engineering Society* 34(11):867-80, 1986.

- "Editing Time-varying Spectra." *Journal of the Audio Engineering Society* 35(5):337-51, 1987.

- "Analysis and Synthesis of Musical Transitions Using the Discrete Short-time Fourier Transform." *Journal of the Audio Engineering Society* 35(1/2):3-14, 1987.

- "Implementing Table Lookup Oscillators for Music with the Motorola DSP56000 Family." Presented at the 85th Convention of the AES, 1988. Preprint No. 2716.

- "Digital Audio Representation and Processing." *Multimedia Systems*, edited by John F. Koegel. ACM and Addison-Wesley, 1993.

- "Technological Change: The challenge to the audio and music industries" (written version of AES keynote address). *Journal of the Audio Engineering Society,* March 1997.

- (with James Grunke, Ben Novak, Bruce Pennycook, Zack Settel, Phil Wiser, and Wieslaw Woszczyk). "AES White Paper: Networking Audio and Music using Internet2 and Next Generation Internet Capabilities." *Journal of the Audio Engineering Society* 47(4):300-310, April 1999. Presented (with Betsy Cohen and AES President Marina Bosi) to White House National Economic Council, December 1998. http://www.aes.org/technical/i2.html.

- (with Yamaha's Mike Overlin). "Playing with Fire," *Electronic Musician*, May 2003, pp. 31-38 (http://emusician.com/ar/emusic_playing_fire/index.htm, on audio networking over 1394).

Professional Associations and Achievements

- Assistant Editor, *Computer Music Journal*, 1978-1982.
- Co-founder (1980), International Computer Music Association.
- Founder and Series Editor (1984-1996), *The Computer Music and Digital Audio Series.*

- Conference Chair, 1987 Audio Engineering Society (AES) International Conference on Music and Digital Technology (Los Angeles).
- Technical Papers chair, 1992 AES Convention, San Francisco (first AES San Francisco Convention). Technical Papers co-chair, 2002 AES convention, Los Angeles.
- Elected member of the AES Board of Governors, 1992-1994; again 2005-2007.
- Keynote Speaker, November 1996 Audio Engineering Society Convention.
- Fellow (1996), Audio Engineering Society.
- Honorary Member (since 1998), Midi Manufacturers Association (MMA).
- Convention Chair, 2004 AES Convention, San Francisco. Recipient of an Anderton Award, Pro Sound News, December 2004, p. 30.
- Convention Chair, 2006 AES Convention, San Francisco.
- Convention Co-chair, 2008 AES Convention, San Francisco.
- Chair, Audio Engineering Society Convention Policy Committee, 2006-2008.
- Technical presentations and session chair at various conferences such as Audio Engineering Society, Acoustical Society of America, International Computer Music Conference, DSP World.
- Member of review board, *Journal of the Audio Engineering Society.*
- Conference paper reviewer for many International Computer Music Conferences (ICMC).
- Member, Acoustical Society of America. Senior Member, IEEE.

Further qualifications

Functionally bilingual in German. Reading ability in French, Dutch. Some experience with Spanish, Italian, Japanese, Latin. Separate list of foreign language experience available on request. Extensive experience travelling abroad and communicating with foreigners.

Other activities

I currently enjoy spending time with my family and hiking. In earlier years I have especially enjoyed travel, aikido, weightlifting, operating a Maerklin Z-gauge model railroad, performing a wide variety of folk and classical music, and attending musical events. Member of Toy Train Operating Society of America.

References

Full vita and references from industry and academia available on request.

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